Vadose Zone Fact Sheet
Lawrence Livermore National Laboratory Main Site

Background: Lawrence Livermore National Laboratory (LLNL) Main Site occupies 3.2 km^2 (800 acres) in southern Alameda County, adjacent to Livermore, California. LLNL is a multidisciplinary research facility owned by the Department of Energy and operated by the University of California.

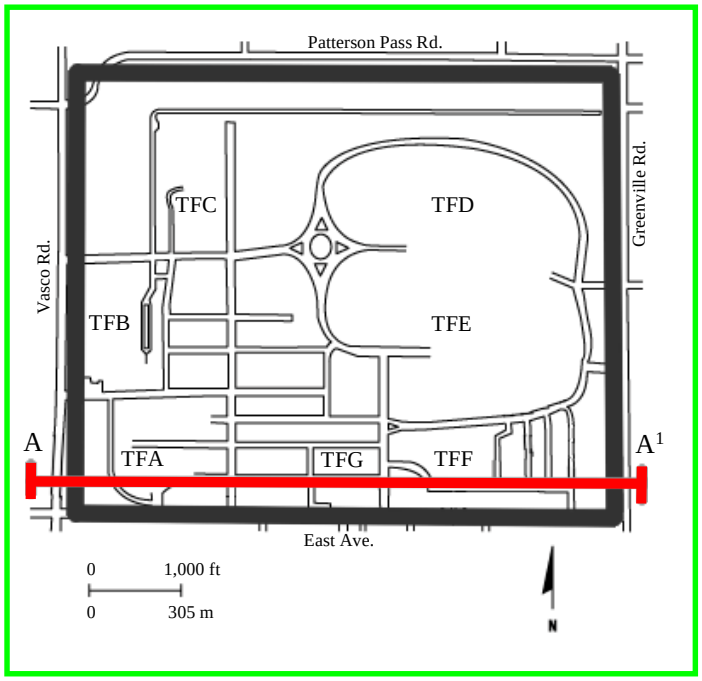
Issues: The Main Site is located adjacent to subdivisions of the City of Livermore, and various stakeholders are actively involved with site activities. The majority of vadose zone contamination has either been remediated or will be addressed by future remediation. Vadose zone contamination of volatile organic compounds (VOCs) in formations with low permeability is hard to remove, and LLNL is investigating innovative technologies, such as electro-osmosis, to remove these VOCs.

Vadose zone infiltration: Infiltration through the vadose zone provides local ground water recharge. Recharge of natural runoff (excluding artificial recharge) through the streambeds accounts for approximately 42% of the recharge, direct rainfall accounts for about 40% of the recharge, and irrigation 18% of the recharge.

Vadose zone characterization/remediation: Initial characterization has been completed and the site is undergoing remediation, including the completed thermally enhanced soil vapor extraction of gasoline and ongoing VOC soil vapor extraction systems in the southeast quadrant of the site. In addition, waste pits and a landfill were excavated and backfilled in 1982 through 1984. Polychlorinated biphenyl (PCB) contaminated soils have recently been excavated.

Precipitation: The climate is semi-arid with an average annual precipitation of 36 cm (14 in).

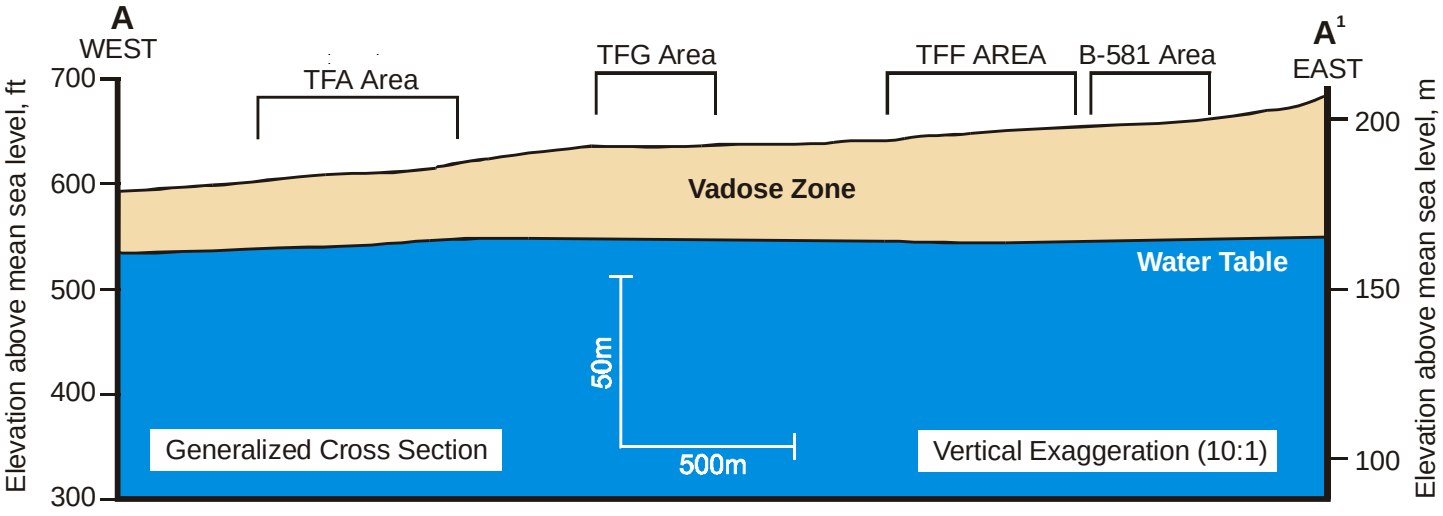
Surface Water: Two intermittent streams traverse the area. Other intermittent surface water sources are storm-water runoff, treated effluent, and cooling and other process water discharged to the storm sewers. A drainage retention basin/pond is located in the central portion of the site.



Geology: The land surface is relatively smooth, slopping gently downward to the northwest. Elevations range from 240 m (670 ft) above mean sea level to 174 m (570 ft). About 732 m (2,400 ft) of marine and continental sediments overlie bedrock.

Vadose zone thickness: Ranges from 37 m (120 ft) in the southeast corner of the site to 9 m (30 ft) in the northwest corner of the site.

Major contaminants of concern: VOCs (primarily TCE and PCE) , PCB, tritium, fuel hydrocarbons, and chromium.



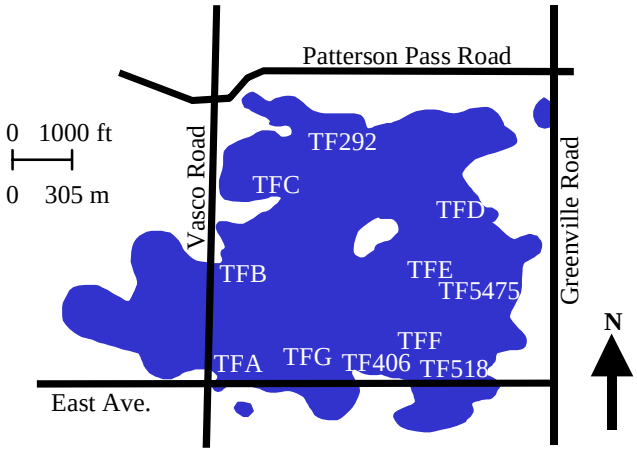
September 2000

Ground Water Fact Sheet
Lawrence Livermore National Laboratory Main Site

Background: Lawrence Livermore National Laboratory (LLNL) Main Site occupies 3.2 km^2 (800 acres) in southern Alameda County, adjacent to Livermore, California. LLNL is a multidisciplinary research facility owned by the Department of Energy and operated by the University of California.

Hyrogeology: Ground water flow is generally from the northeast to the southwest at 23 m (75 ft) per year. With the operation of ground water injection and extraction wells since 1989, localized flow directions have been altered, minimizing off-site migration of contaminated ground water. There are numerous plumes at distinct depths; some are co-mingled, some are completely separate, and some are separate but overlying other plumes. Because plumes overlie other plumes, the plume map gives the appearance of one large co-mingled plume, while in reality the superimposed plumes are separate.

Issues: In 1983, volatile organic compounds (VOCs) were detected in domestic water supply wells west of the site. Bottled water was provided to nearby residents and all affected wells were permanently sealed.



Cumulative Extent of VOC Plumes

Ground water characterization/remediation: Lawrence Livermore National Laboratory **(**LLNL) is using optimized hydraulic control, source removal, and advanced technologies to clean the ground water, with a network of treatment facilities employing air stripping, catalytic reductive dehalogenation, ion exchange, electro-osmosis, and granular activated carbon technologies. Monitored natural attenuation is being proposed and used where appropriate. Further, off-site migration of contaminated ground water has been eliminated and ground water contaminant concentrations have been steadily decreasing. Dense non-aqueous phase liquids (DNAPLs) potentially exist at the TFD, TFE, and TF5475 areas and light non-aqueous phase liquids (LNAPLs) potentially exist at the TFF area.

Ground Water Use: The current ground water use is predominantly agricultural with limited residential.

Plumes Identified by Treatment Areas	Primary Contaminants	Depth	Remedial Approach
TFA	VOCs, primarily PCE	43 m (140 ft)	P&T, PSR
TFB	VOCs, primarily TCE	40 m (130 ft)	P&T, PSR
TFC	VOCs, primarily TCE	18 m (60 ft)	P&T, PSR
TFD	VOCs, primarily TCE	21 m (70 ft)	P&T, PSR
TFE	VOCs, primarily TCE	34 m (110 ft)	P&T, PSR
TFF	Fuel hydrocarbons	30 m (100 ft)	P&T/SVE/MNA
TF406	VOCs, primarily TCE	30 m (100 ft)	P&T, PSR
TFG	VOCs, primarily TCE	26 m (85 ft)	P&T, PSR
Building 292	Tritium	14 m (45 ft)	MNA
TF5475	VOCs, primarily TCE; tritium	30 m (100 ft)	P&T, PSR
TF518	VOCs, primarily TCE	34 m (110 ft)	P&T, PSR

VOCs = volatile organic compounds; PCE = perchloroethylene; TCE = trichloroethylene; P&T = pump and treat; PSR = phased source area remediation; SVE = soil vapor extraction; MNA = monitored natural attenuation